

# PATENT SPECIFICATION

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DRAWINGS ATTACHED.

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## COMPLETE SPECIFICATION.

### Emulsification Apparatus.

I, EIICHI IKEDA, a Japanese subject, c/o Nichireki Kagaku Kogyo Company Limited, of No. 101, 6-chome Ogu-machi, Arakawa-ku, Tokyo, Japan, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an apparatus for emulsifying bituminous materials such as asphalt, coal tar, or coal tar pitch, plastics, mineral oils, fats and fatty oils, natural and synthetic resins, rubber, rubber-like substances, fillers, pigments and dyestuffs, either alone or with other substances.

One object of the present invention is to provide an emulsifying apparatus which is capable of emulsifying the substances to be emulsified effectively in a short time.

Another object of the present invention is to provide an emulsifying apparatus capable of easily emulsifying, substances which have only with difficulty been emulsified by conventional emulsifying apparatus using mechanical mixing or high frequency oscillating devices such as are known in the art.

This invention, more particularly, has reference to an emulsifying apparatus in which the substances to be emulsified are stirred and mixed with emulsifying liquid within a magnetic field, the magnetic flux being arranged to pass through the apparatus in a direction perpendicular to the direction of stirring.

This invention consists in an emulsifying tank made of a material permeable to magnetic flux and able to receive the substances to be emulsified, a device for creating a magnetic flux through the tank, consisting either of one or more solenoids through

which an electric current is passed, one or more permanent magnets, or one or more pairs of electrodes to which an electric current is applied a mechanical stirrer capable of motivating the substances within the tank to move in a direction substantially perpendicular to the direction of the magnetic flux and inlet and outlet conduits for the substances being emulsified.

In conventional emulsifying apparatuses, a tank is provided with a stirring and mixing device, an emulsifier of colloid-mill type and substances to be emulsified and emulsifying liquid are mechanically exposed to high-speed agitative emulsification. Another type of known process is to mix and emulsify substances by means of a frequency oscillations using ultra-short waves.

However, in all these processes the stirring and mixing efficiency is increased only by mechanical means.

The accompanying drawings illustrate embodiments of the present invention, in which:—

Fig. 1 is a perspective view of the apparatus.

Fig. 2 is a front view of a longitudinal section of the same, and

Fig. 3, 4, 5 and 6 show front views vertically cut of other embodiments of the present invention.

An emulsifying apparatus of the present invention is explained with reference to Figs. 1, 2 and 3.

1 indicates a cylindrical emulsifying tank, which is made of materials that are pervious to magnetic flux such as synthetic resin, black lead processed by mixing synthetic resin therewith and hard porcelain.

At the bottom of said vessel is fitted a siphonic outlet conduit, which has an ex-

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haust pipe 3 and a cock 4 so that there is a constant amount of substances in the emulsifying tank. The substances are poured in from an inlet conduit 5.

5 Around the outside wall of said tank 1, a solenoid 6, made of copper wires or copper pipe, is fixed, and an electric insulator or electrically insulating layer may be placed between the outer wall of the tank and the solenoid, so that the magnetic flux created by the current applied to said solenoid permeates well into said emulsifying tank.

10 Said solenoid 6 may be covered with insulating material and immersed in said tank as shown in Fig. 3.

15 Provided with said tank are one or more stirrers 8 whose rotary shafts 7 may be made of electrically conductive material, the shafts being arranged to be rotated by a pulley 9, a belt 10, and an electromotor 11, all fitted outside the tank.

20 When said stirrers 8 are made, partially or wholly, from an electrically conductive material such as metal or metallic oxide or mixtures thereof electrically insulated on the outside, they induce a greater flux through the central portion of said emulsifying tank, and the invention therefore gives better results. The stirring and mixing operation is more effective if said emulsifying tank 1 has a cross-section with a many sided figure, or is provided with several projections in its cylindrical inside. Alternatively, as shown in Fig. 2, the blades of the stirrer are recessed so that there is a space between the rotary shaft and the cage of the blades, through which the substances, after entering the tank and while being stirred and mixed well, can flow smoothly. The direction of stirring which motivates and mixes the substances and the direction of the magnetic flux which passes through said emulsifying tank are at right angles and intersect each other.

45 Said solenoid 6 may be made up of several solenoids connected in parallel.

50 A magnetically permeable plate, consisting of a carbon steel plate, a silicon steel plate, a copper plate, nickel or cobalt alloy, is preferably inserted between the solenoid and the tank with the electrically insulating material fitted between the solenoid and the plate in order to increase the magnetic flux through the tank.

55 Also for generating magnetic flux, when said solenoid 6 is charged with an intermediate or high frequency current, the solenoid should be made of copper pipe so that it may be cooled by water or other cooling medium.

60 A permanent magnet may be substituted for the solenoid.

65 Furthermore, as is clearly illustrated in Fig. 3, the installation inside the tank of the magnetic flux creating device makes it pos-

sible for all the magnetic flux to permeate the tank, which produces a better result in the invention.

The operation of the emulsifying apparatus is explained in the following description.

70 1. Stirrers 8 are rotated by an electromotor 11.

2. Magnetic flux 12 is generated in the emulsifying tank 1, by charging a suitable current, such as alternating or direct current or a combination of the two, through one or more solenoids 6. When alternating current is used for the creation of said flux, proper selection of both frequency and wavelength for each emulsification depends on the properties of the substance to be emulsified and its emulsifying liquid. Also when intermediate or high frequency current is used the solenoid should be cooled by passing water or other cooling medium through the pipe.

3. First, the cock 4 of an outlet pipe 3 which is disposed at the bottom of said emulsifying tank, is closed. The required quantity of emulsifying liquid is passed into said tank through inlet conduit 5 together with substances to be emulsified. The substances being motivated by said mixers 8 to cross said magnetic flux, are both mixed and well emulsified, and when the mixing is complete are discharged continuously and smoothly through a siphonic outlet conduit 2 fixed at the bottom of said tank. After the operation, said cock 4 of the exhaust pipe 3 is opened to discharge emulsified mixtures which remain in said emulsifying tank.

An emulsifying apparatus with the structure described above is very useful, especially in continuous operations. On the other hand, an apparatus of the kind which is shown in Figs. 4 and 5 is more useful for non-continuous operations.

Another embodiment of the invention will be described with reference to Fig. 4.

75 To the side of a vessel 14 made of iron plate or similar material, which has an opening 13, is fixed a cylindrical emulsifying tank 15 made of materials that are easily permeated by magnetic flux such as synthetic resin, black lead processed by mixing synthetic resin thereto, and hard porcelain, to which solenoids 6, a rotary shaft 7, stirrers 8 conductive or non-conductive, a pulley 9, a belt 10, and an electromotor 11 are provided in a manner similar to that described for the emulsifying apparatus shown in Figs. 1, 2, and 3. A suitable liquid transporter 16, such as a pump, connects the vessel 14 and emulsifying tank 15 and is arranged so that the mixed contents of the vessel 14 may

be transported into said emulsifying tank 15. The substances are circulated in the vessel by a transmission shaft 18 with additional stirring propellers 17, rotated by an electromotor 11 or any other suitable device.

The number of emulsifying tanks 15 fixed to the vessel 14 may be increased to improve the efficiency of the operation.

The operation of the above emulsifying apparatus is explained by the following description.

1. A certain emulsifying liquid to which the substances to be emulsified are added and preliminary mixed flows into a vessel 14 from an opening 13, with operation of additional stirring propellers 17.
2. Next a liquid transporter 16 is switched on to force the mixtures in vessel 14 into an emulsifying tank 15, where they are further mixed.
3. As stirrers 8 are rotated by means of electromotor 11, belt 10, pulley 9, and rotary shaft 7, the current is applied to the solenoids for the creation of magnetic flux in the same manner that is in the description of Figs. 1, 2 and 3.
4. Thus by the processes just mentioned, said substances to be emulsified and the emulsifying liquid which have been mixed in said vessel 14, are so easily emulsified in their passage through emulsifying tank 15 that the emulsification takes place in a very short time. Fig. 5 shows that said solenoids 6 of Fig. 4 may be fitted inside the emulsifying tank 15.

In this case, better efficiency can be obtained, because all the magnetic flux permeates into said emulsifying tank.

Another embodiment of the invention will now be described with reference to Fig. 6.

A rotary body 19, rotatable by a shaft 7, is fitted in an emulsifying tank 15 and electrodes 20, 21 are also coupled and fitted in the tank. A current is applied to these electrodes (the current being direct, or alternating, of high, intermediate, or low frequencies). By rotating said body 19, magnetic fluxes are created in a doughnut-like space between the two electrodes, the fluxes passing through the material to be emulsified and emulsifying liquid, which flow through passage 22. Said mixture, by rotary movements and magnetic flux both originating from said rotary body, is activated with energy, and as a result, a stabilized emulsion is obtained. In this case said electrodes may be substituted by suitable permanent magnets, and also additional stirring propellers 23 may be provided on said rotary shaft 7 if necessary. Said passage 22 may be also enlarged or narrowed to control the flow by replacing the rotary body 19 with one having a smaller or larger diameter.

In Fig. 6, the apparatus is shown with outlet conduit 2, inlet conduit 5, bearings 24, collar 25 made of electrically insulating material, and brush 26.

In the emulsifying apparatus of the present invention, as above described, by using magnetic flux and a stirrer, the substance to be emulsified and its emulsifying liquid are motivated to cross lines of said flux, so that the energy possessed by said flux activates the substances causing them to be further homogenized and mixed for their emulsification by means of mechanical stirring.

Thus obviously the present emulsifying apparatus is basically, quite different from any conventional apparatus of the kind which merely involves mechanical agitation or high-speed vibration, so that the present apparatus has exclusive abilities, especially that of easily emulsifying such substances as are impossible for any apparatus of the usual type.

In the case of production of cationic emulsions, extremely good results can be obtained.

Also the present apparatus can be made very small so that it can be used on a small scale without using large quantities of electric power.

Furthermore, the present apparatus is not only useful for emulsifying substances but may also be used for promoting other reactions.

#### WHAT I CLAIM IS:—

1. An emulsification apparatus comprising an emulsifying tank made of a material permeable to magnetic flux and able to receive the substances to be emulsified, a device for creating a magnetic flux through the tank, consisting either of one or more solenoids through which an electric current is passed, one or more permanent magnets, or one or more pairs of electrodes to which an electric current is applied, a mechanical stirrer capable of motivating the substances within the tank to move in a direction substantially perpendicular to the direction of the magnetic flux and inlet and outlet conduits for the substances being emulsified.

2. An emulsification apparatus as claimed in claim 1, in which the device for creating a magnetic flux comprises one or more solenoids wound round the outer circumference of the emulsifying tank.

3. An emulsification apparatus as claimed in claim 1, in which the device for creating a magnetic flux comprises one or more solenoids fitted within the emulsifying tank.

4. An emulsification apparatus as claimed in any one of the preceding claims in which the solenoid or solenoids consist of turns of copper wire or copper pipe.

5. An emulsification apparatus as

claimed in claim 2, in which a magnetically permeable plate is fitted between the solenoid and the emulsifying tank and an electrically insulating material is fitted between the solenoid and the plate.

6. An emulsification apparatus as claimed in any one of the preceding claims in which the stirrers are partially or wholly made from electrically conductive material and their outer surfaces are electrically insulated.

7. An emulsification apparatus as claimed in any one of the preceding claims in which the current flowing through the solenoid is either a direct current or a high,

intermediate, or low frequency alternating current.

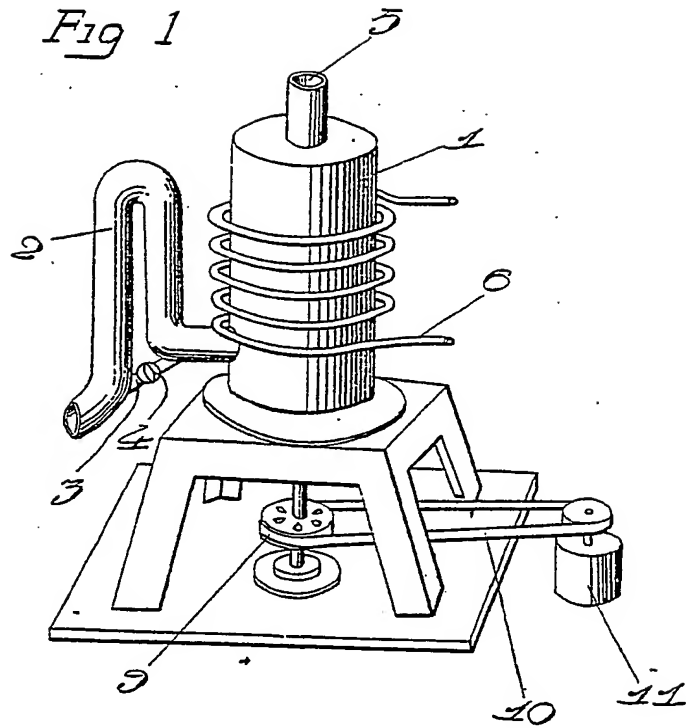
8. An emulsification apparatus as claimed in claim 1 in which the device for creating a magnetic flux comprises one or more electrodes oppositely fitted within the emulsifying tank.

9. An emulsification apparatus substantially as hereinbefore described with reference to the accompanying drawings.

MARKS & CLERKS,  
Chartered Patent Agents,  
Agents for the Applicants.

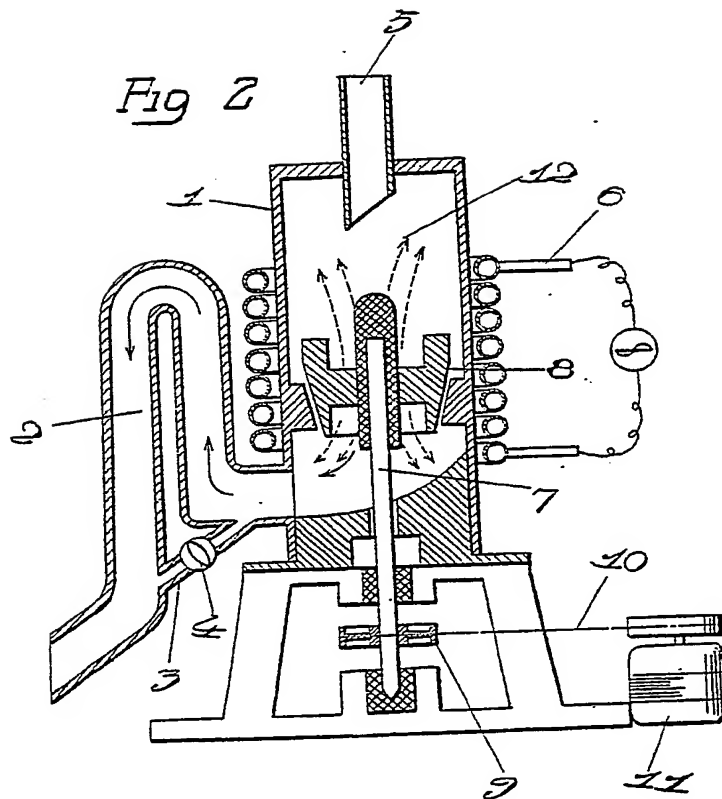
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*Fig 1*



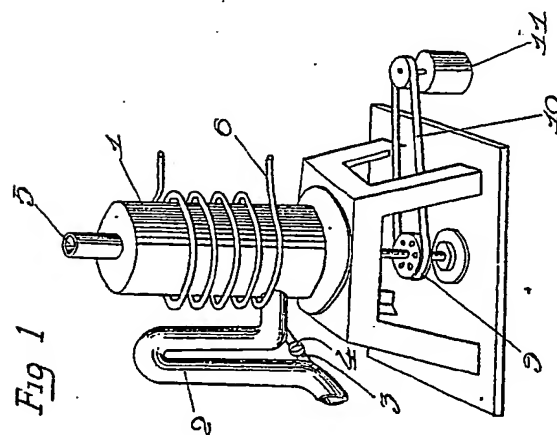
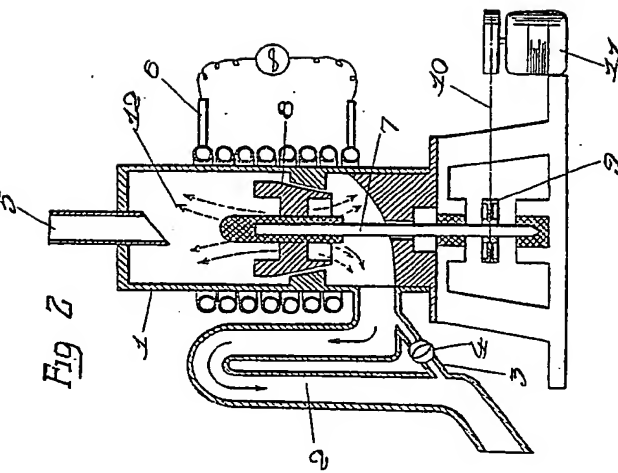
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*Fig 2*

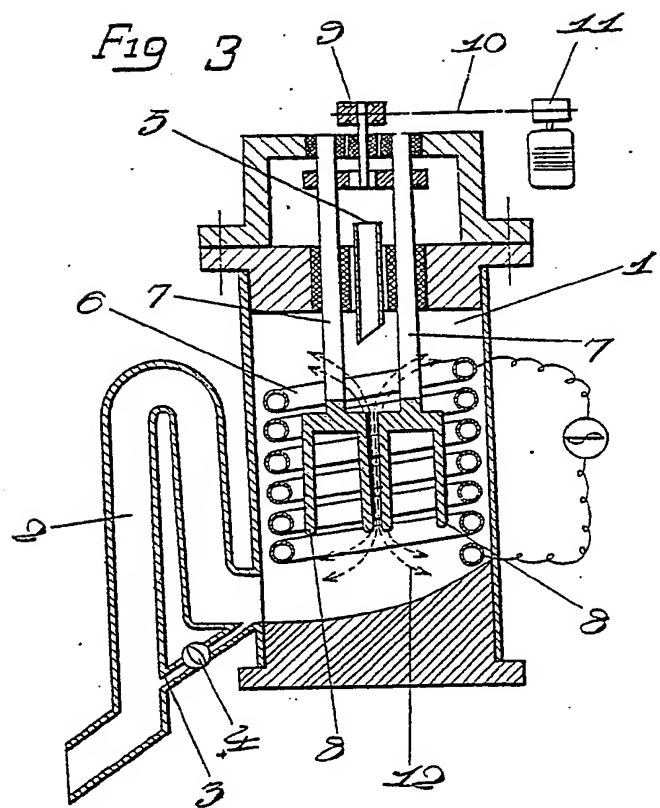


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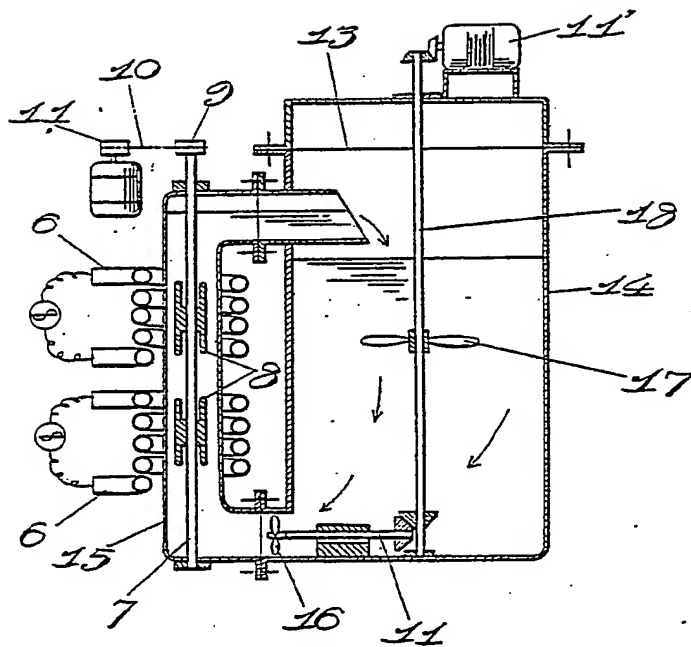
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Fig. 4



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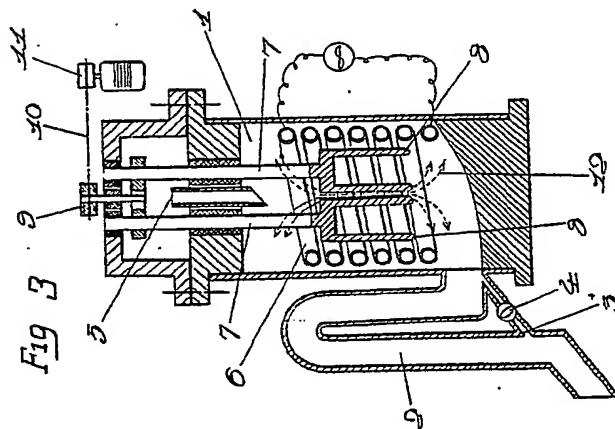
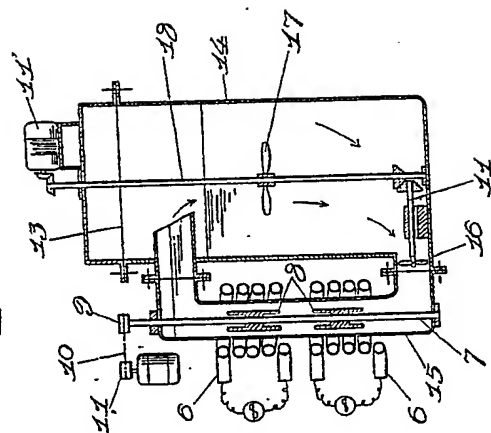
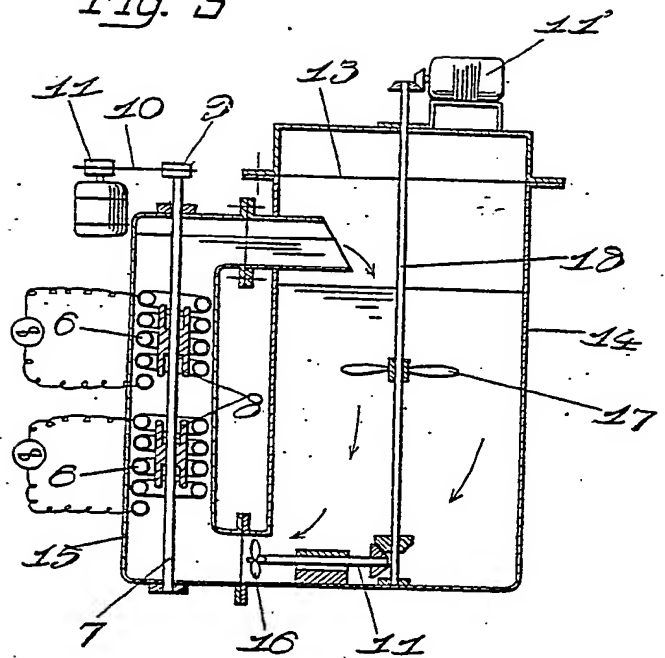


Fig. 4



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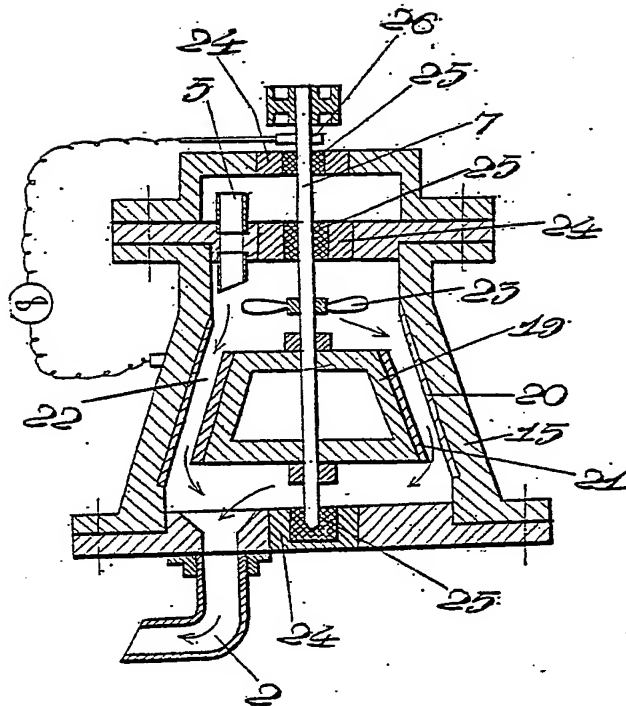
Fig. 5



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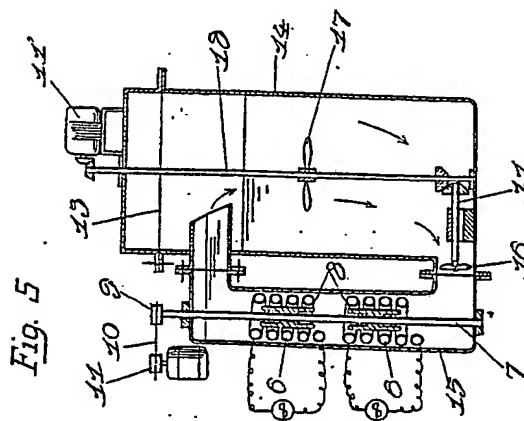
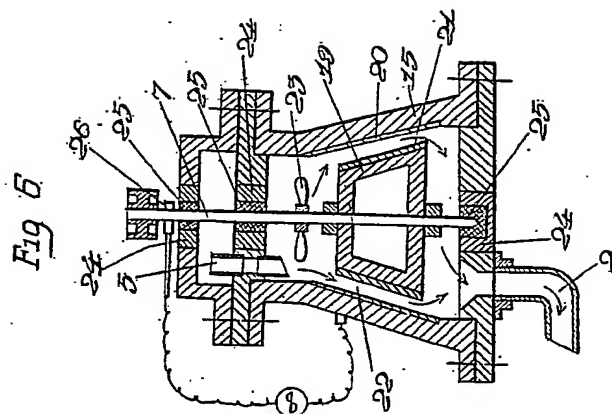
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Fig 5



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